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ABSTRACT

This study of the impact of technology on education is an in-depth case study of 25 educational institutions, including both public school districts and colleges and universities. Information was gathered through the use of a lengthy questionnaire and a comprehensive telephone and/or site visit interview. Aspects of the study include the role of technology--primarily computers--in the instructional program, in policy structure, in management support services, and in teacher training and teaching functions. The strategies employed by the study institutions provide a frame of reference for current and future technological trends in education. (Author/JB)

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Technology in the Schools:

Trends and Policies [1]

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Abstract

This study of the impact of technology on education is an in-depth case study analysis of 25 educational institutions, including both public school districts and colleges and universities. Information was gathered through the use of a lengthy questionnaire and a comprehensive telephone and/or site visit interview. Aspects of the study include the role of technology in the instructional program, in policy structure, in management support services, and in teacher training and teaching functions. The strategies employed by the study institutions provide a frame of reference for current and future technological trends in education.

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Introduction

This study was conducted as part of an international survey of the impact of the new information technologies on education, funded by the Organization for Economic Cooperation and Development in Paris. The findings provide information on how selected educational institutions in the United States are implementing the new technology and the resulting impact on the curricula and institutional structures.

Overview

In a few short years, the area of new information technologies in schools, colleges, and universities has become a complex and highly controversial field. Various national commission reports on the status of American education have hailed, damned, or ignored the entire movement. In Washington, D.C., the nation's lawmakers have proposed implementing tax deductions for computer donations, but remain unsure whether such a move would help or hurt the drive to excellence. Computer companies continue to manufacture and sell equipment to schools, often faster than the educators can

adjust. With heavy community and national pressure to place the new information technologies in the classroom, few at the local level are clear about the best way to proceed.

What is clear, however, is that the new information technologies are not just another passing educational fad. Unlike the programmed instruction of the 1960's or similar failed trends, the new information technologies have permeated all walks of life. Using technology in schools is not just a new way to teach concepts; it is an essential part of training our students to be prepared for life after school.

This clarity begins to fade, though, as questions emerge about defining the appropriate function of technology in schools, stipulating the content and process of teaching with or about computers, identifying jobs for which to train students, planning for the future in such a fast-changing field, assuring equal access to the benefits of the new technology, and managing and financing the privilege of using the technology. This report addresses such issues indirectly by examing how a select group of our nation's educational institutions are responding to the challenge.

Method

This report utilizes a multiple case study analysis approach. The information was obtained from the participating institutions in late 1983, in a variety of ways. A detailed questionnaire was sent to each institution,

followed up by a lengthy telephone interview (averaging 90 minutes each) and/or a site visit interview (averaging several hours) with appropriate staff member(s). Each interview was guided by the structured questionnaire and sought to clarify the points in the questionnaire.

After each interview, the study consultant who conducted the interview developed a detailed written description of the institution's technology program, following a standard format. At the completion of all case studies, the consultants worked, both individually and as a group, to analyze trends and policies that could be generalized across the studies as well as strategies that were unique to individual institutions. The final report consists of a summary for the school settings, a summary for the colleges/universities, and a case study for each of the participating institutions. For the sake of brevity, this paper will not include the individual case study reports, but will summarize the trends and policies and pinpoint interesting unique variations.

Data Source

The institutions selected to participate in the study were chosen from a group known to be in the forefront of implementing technology programs. This strategy was employed in order to gather the greatest amount of information for educators who are in planning stages and seeking information about approaches that have already been undertaken by others. A total of 40 institutions were originally contacted to participate in the study. Of these,

25 were included in the final report. The others were excluded due to either lack of cooperation or insufficient information for a complete case study. Of the 25 institutions, 16 involve public school settings and nine are colleges or universities.

Public School Settings. Of the 16 public school settings, 14 are districts which serve kindergarten through grade twelve. One district serves only grades nine through twelve. One institution is a not-for-profit service organization which serves about 85 small school districts in the areas of educational research, testing, consulting, and microcomputer services including training, group purchase, and software evaluation.

The 16 institutions are geographically spread across the United States. Two are located on the East Coast, six are in the Midwest, seven are in the Southwest, and one is on the West Coast. Similarly, the institutions span the size continuum: three of the districts serve fewer than 6,000 students, eight serve from 11,000 to 75,000 students, and four serve more than 100,000 students each. The service organization serves districts of small size. Eight of the institutions serve primarily White middle-class students; four districts serve a very mixed population in terms of ethnicity and socioeconomic status; three districts serve a large percentage of Black students; and one district serves a large percentage of Hispanic students.

Colleges/Universities. Of the nine colleges and universities, seven serve undergraduate and graduate students, one is a graduate school, and one is a community college. Six are public and three are private institutions. They

span the United States geographically: three East coast, two Southwest, one Midwest, and three West Coast. With regard to size, the nine institutions range from serving 1,500 students to 35,000 students.

Results

Public School Settings

Instructional Program. Public school districts have generally modified their instructional programs to incorporate the use of technology in three ways: (1) teaching with computers (computer-assisted instruction), (2) teaching about computers (computer literacy, computer science, programming), and (3) using computers to record students' progress through the instructional program (computer-managed instruction). The case studies indicate wide variations in the extent to which districts use computers for these purposes, as well as in the level of student and subject matter targeted. However, some generalizations are possible:

1. The primary use of computers at the elementary level is for computer-assisted instruction in mathematics and reading.

2. Computer literacy courses are generally introduced at the junior high level (seventh and eighth grades) and then continued at the senior high level.

3. The impact of technology at the senior high school level is most evident in the addition of computer science courses and computer-related courses in mathematics, science, and vocational education (business applications).

4. The most frequently reported use of computer-assisted instruction is for drill and practice, followed by its use for enrichment and for remedial purposes. Very minimal use is reported for problem-solving, simulations, or the development of reasoning skills.

5. The number of students and teachers involved in some computer-related instruction ranges from as little as two percent to as much as 100 percent in a given district. The average seems to be about 10 to 25 percent of the students involved at the present time.

6. The amount of time that students spend at the computer also varies greatly from district to district. The average is estimated at one or two sessions per week, approximately 15 to 20 minutes per session.

7. The students with greatest access to the computer are those at the two ends of the normal distribution: the gifted and talented student at one end, and the slow, disadvantaged, and/or special education student at the other end. This situation is a result of two phenomena: (1) prepackaged software is generally geared toward either drill and practice/remediation for slower students or enrichment for brighter students, and (2) government resources are more available for students of special populations than for the "average" student.

8. Some districts have defined "computer literacy" through the development of a list of objectives or skills that students are expected to master at a given level. In some cases, these objectives define a new "strand" of the curriculum, parallel in structure to a language arts or mathematics strand. In other cases, the objectives are added to an existing strand, such as that of mathematics or science, but no real integration has been reported.

9. Only a few districts use computer-managed instruction on a systemwide basis; many districts, however, use the computer to keep track of special education students' progress through their Individual Education Plans.

10. Parents are overwhelmingly supportive of the use of technology in the instructional program; many districts initiated implementation plans largely in response to pressure from parents. Nevertheless, very little is occurring in the area of home-based learning or other distance learning in conjunction with the school.

11. Several districts utilize instructional television, cable television, closed circuit television, and/or radio to supplement the regular program of instruction. Except in a few rare cases, these distance strategies are not extensively used for instructional purposes.

Policy Structure. Indications of policy changes related to technology are

apparent in all the respondent districts. Some governing boards have stated explicit policies, others have indicated implicit policies through certain administrative actions or programs, while others are at the investigative stage of policy-making. The observed policy changes have affected five areas: (1) the instructional program, (2) financial allocations, (3) administrative staffing, (4) physical facilities, and (5) communications.

Policies regarding the implementation of technology in the instructional program fall into two types: those that focus on the student and those that focus on the teacher. Some districts have addressed their policies to the curriculum and what each student is expected to learn. Others have focused their policies on teacher training and what new competencies teachers should demonstrate. A few districts have developed plans which have integrated both these components.

1. Many governing boards are considering or have already instituted new requirements for graduation which include a demonstration of computer literacy. The extent to which "computer literacy" is explicitly defined varies greatly from district to district.

2. A few districts have mandated teachers to take some computer training which is arranged by the district. Some districts will not approve a school's purchase of hardware until an appropriate number of teachers have been trained. One respondent district requires that all the teachers pass a certification test to indicate knowledge of computers.

Policy changes are most evident in the area of financial allocations. The implementation of technology is expensive, and districts have utilized a wide variety of strategies to meet the costs of this endeavor. A critical point which must be noted is that even in districts which are reducing staff as a budget measure, resources are being found to purchase computer hardware

and software.

1. Many districts are directing state and federal funds, particularly those targeted for special populations, to the purchase of computers.

2. Some districts are utilizing state textbook money for the technology effort.

3. Parent-teacher organizations are helping some districts to purchase computers.

4. An increasing amount of resources is being provided by the private sector. Technological businesses in particular have been providing school districts with expertise, equipment, and financial assistance for technology. One district's governing board has a policy to match funds given by any outside source for technology. Other districts are working in conjunction with computer companies for the development of software to meet the district's needs. Several computer companies offer teacher training as part of a computer purchase.

5. Some governing boards have added the costs of the technology effort to the regular budget of the district.

Nearly all districts have addressed the need to designate <u>administrative staff</u> to coordinate the technology effort in the district.

1. Most districts have hired at least one and usually more new central office administrators to plan and coordinate the implementation of technology in the instructional and/or management area of the system.

2. Two large respondent districts have established a Department of Technology. The functions of such a department may include centralized procurement of hardware and software, evaluation of hardware and software, maintenance, teacher training, and implementation assistance to individual schools.

3. Some districts prefer to utilize all levels of staff in the planning and implementation efforts, rather than to designate specialists for the role.

4. Some small districts have added new technology-related responsibilities to the assignments of existing staff members, rather than hiring new

staff.

All respondent districts reported policy changes with regard to the provision and utilization of physical resources.

1. Many districts have established or plan to establish a computer laboratory in each school building. Often space is made available from empty classrooms, with appropriate rewiring and security measures added.

2. Some districts prefer to have the computers available in each classroom, particularly at the elementary level. In this situation, the computers are usually kept on desks designed to be easily moved.

3. Some schools have integrated the computers into the school library or existing media center.

4. Several districts which are planning the development of new school buildings have modified the architectural designs to include computer laboratories.

Changes are evident in most districts in the amount and type of communications, both in-house and to parents and the public, that have occurred as a result of the new technology.

1. Most districtss report a definite improvement in the information delivery system to their governing boards, both in quantity and quality of information.

2. Some districts report that members of their governing board show a greater selectivity and sophistication in the information requested.

3. Better information is available to the public in several districts as a result of using cable television and word processing equipment.

4. In several districts, administrators use closed-circuit television and radio to communicate with staff in local schools.

5. In several districts, technology is used to communicate with parents in a more timely and accurate way than ever before. Districts report using the computer to notify parents regarding school assignments, immunizations, absences on a daily and per class basis, report cards, grades, and test results. One district cautions against sending too

much or too complicated information to parents, simply because the information is now so easily available.

Management Support Services. Most of the respondent districts have been using technology for management support services for longer than they have used it in the instructional area. Furthermore, there is greater consensus among the districts as to the need and purpose of technology for management services than there is for instructional uses.

1. The most frequently cited use of technology in the management system is for financial accounting -- budgets at both the district and school level, payroll, activity funds, and similar financial information.

2. Other frequently cited uses of technology in the management system include purchasing, warehousing, personnel, inventories, replacement schedules, student transportation, food services, and program evaluation and research.

3. Many districts utilize computerized information to help manage the instructional program, including the scheduling of high school classes, grade reporting, regular notifications to parents, enrollments by secondary subject area, student records, student transcripts, student attendance, and similar information.

4. A few districts use a computer operation to scan, score, and record test data, for standardized achievement tests and/or criterion-referenced tests.

5. Many of the districts, particularly the larger ones, use a mainframe computer for most of the management services which require a large data base. Some of the smaller districts hook up to a mainframe at a regional service center, while others are increasingly turning to using microcomputers for administrative tasks.

6. One district uses the computer to generate expectation levels for each classroom in the district, based on about 30 criteria including test information and school characteristics. For each class which achieves below expectations, a central office staff person works with the teacher to determine the problem area and improve instruction.

7. One district reports that computerized food management has enabled the district to keep lunch prices unchanged for three years, and estimates a savings of $500,000 from preventive maintenance information generated by the computer.

Teacher Training and Teaching Functions. The patterns of the development and implementation of teacher training programs vary as greatly as those related to the instructional program.

1. Most districts have an ongoing professional growth program for their teachers, to which new courses related to technology have been added. These programs typically are optional, are scheduled after school hours, and offer inservice credit to the teachers toward increased tenure or pay scale level. In some districts, this represents the entire teacher training program in the technology effort; in other districts, this format is provided in addition to some more centrally-administered program. The districts with this option report heavy teacher participation and interest for technology-related courses.

2. Several districts are mandating all teachers to participate in a centrally-administered training program. In some cases, this training is conducted during one school year. In other cases, the training is phased in over several years, usually starting with the teachers who will teach with computers first.

3. Some districts are providing training only for selected personnel, who are then expected to conduct training and/or act as a resource person at their local school. This responsibility is usually added to the staff person's regular duties (as teacher, librarian, assistant principal) with no additional salary.

4. A few districts have a decentralized training system, in which each school develops and implements its own training program in line with the needs of the individual school. In some of these cases, the district will not approve a school's request to purchase computer equipment until adequate provision has been made for teacher training at that school.

5. Very little preservice training of student teachers is conducted by the respondent districts.

6. The extent of training provided by districts ranges from two-hour workshops to one district which offers a 296-hour certification program for "Teacher Technologists."

7. Many districts include administrators and Board members in the training effort.

8. The content covered in the training programs ranges from programming and word processing skills to information about hardware, software, technical vocabulary, implementation strategies, operations, and

classroom applications. Only a few districts focus on the broader aspects of technology and society, the future of technology, or the interdisciplinary integration of technology into the curriculum.

9. Generally, teaching functions have not changed, except in the sense that teachers who are now designated to teach computer literacy, awareness, or science must learn a new discipline or content area. One district, which requires all teachers to pass a certification test, expects all teachers to demonstrate new competencies in this area. In the districts which train teachers to become trainees themselves or resource persons at their own schools, new functions are expected for those teachers. But the average classroom teacher is not teaching in a new or different way as a result of technology.

10. Generally, teacher compensation and evaluation have not changed as a result of technology.

11. Methods of teacher training in technology all emphasize a "hands-on" approach.

12. The impact of teacher training has been rated as rather high on the teacher participants, particularly in terms of attitude and interest.

13. Most districts report that it is too early to rate the impact of teacher training on the overall quality of instruction.

Colleges and Universities

Instructional Program. Instructional programs surveyed were in various stages of development -- some were in beginning stages (one to two years); others have been in place 15 or more years. Among the more salient features of these instructional programs are the following:

1. As in the public school settings, the focus of the new information technologies for instruction is on the use of computers, with much less emphasis on other technologies such as television (cable, broadcast, closed circuit), radio, or interactive audio and video systems.

2. Computer courses and technology-related degree programs are offered by various departments -- Mathematics, Education, Business, Computer Science, Engineering, and others. As with the public school settings,

more impact has been felt from the addition of new courses and programs than with any interdisciplinary involvement or modification of existing courses or programs.

3. In Departments of Education, student teachers are generally being exposed to the hardware and software representative of school classrooms. Some institutions offer inter disciplinary programs that allow student teachers to specialize in a technology-focused area (such as programming) or in various computer applications (such as school administration). However, overall instructional programs, course content, and methodology for the training of teachers have not been impacted to a substantial degree. The objective seems to be the ability to state that education graduates are "computer literate," but this is not well defined in most institutions.

4. Many of the respondent institutions have used mainframe computers for a long time for research and other large "number-crunching" applications. Usually the use of mainframes is limited to faculty, administrators, and graduate students.

5. In a few institutions, enough microcomputers are available around campus for students of all levels to work on courses in an individualized manner. At the time of this study, however, such a situation is a rarity. Most colleges/universities have centralized computer centers in which all the hardware is housed, with limited availability to students.

Policy Structure. Most institutions reported that formally adopted policies have not been altered substantially by technology; however, these same institutions reported that various practices and precedents have been changed. Among these are:

1. Financial allocations for technology have been increased in all institutions surveyed. In several institutions, these increases are substantial (both in dollars allocated and in percent of total budget).

2. Nearly all institutions have requirements or guidelines to ensure that computer literacy is developed by teacher education graduates. Ways for achieving this goal vary substantially among the institutions surveyed.

3. Most institutions surveyed have a long-range plan for improving the utilization of technology. These plans were reported to be necessary because of the complexity of technological applications in the disciplines affected, their resource requirements, and the need for accountability.

4. Most institutions surveyed have one or more internal technology coordinating committees. Generally, these committees represent the computer service department and each user department.

5. Several institutions surveyed have initiated the use of technology advisory committees to assist in planning the technology program. These committees assist in obtaining resources, obtaining commitments from various groups (i.e. - alumni), and facilitating the desired programs.

Management Support Services. Management support information services are provided by all institutions surveyed. Services that were surveyed include financial, purchasing, equipment and facilities, multi-media (including library), general management information, communications, school-community relations, food services, student transportation, management monitoring and supervision, and program evaluation and research. The following are generalized survey findings:

1. Information services are universally provided utilizing mini or mainframe computers. Networks of microcomputers in concert with the more powerful machines are being developed by many institutions.

2. The acceptance and use of management information by user departments varies greatly among participants in the study. Some participants are in embryonic stages, while others are in advanced and sophisticated stages.

3. The only service provided by all participants is financial. Most provide purchasing, maintenance and inventory, multi-media, general management information, and program evaluation and research. Some are providing communications, community relations (including alumni), and food services information. None provide student transportation information.

4. Most institutions surveyed provide a variety of instructional support services. These services focus on data bases that are relevant to instructional decision-making such as: student identification, characteristics, performance; course information; capital inventory, purchasing and the like; and other instructional management information. Generally, these information services utilize minicomputers or mainframe computers.

Teacher Training and Teaching Functions. A variety of subjects was surveyed -- type and extent of preservice and inservice teacher training, content and methodology of the training programs, teaching functions that are being altered by technology, and personnel practices. The following are salient findings:

1. For the most part, teacher training has not been altered substantially by technology. In most institutions, only a small percent of courses utilize computers in the instructional processes; however, this is changing rapidly as additional microcomputers become available.

2. Teacher training in colleges and universities is generally designed to provide preservice training. Very few cooperative ventures between universities and school systems for inservice training in technology were reported.

3. All participating institutions have established the goal to have their education graduates be "computer literate." The meaning of this objective is not highly specified in many cases, however.

4. Faculty members in the Education Departments who have been trained in technology have generally taken some training voluntarily while in their current position. The percent of computer-trained faculty varied widely among those surveyed; no institution reported all faculty as trained. Many reported that only those faculty who need to incorporate technology-related information in their courses are knowledgeable about computers.

5. Unless a student teacher is specializing in instructional technology, his/her exposure to technology is limited to what is used in classrooms as part of learning about teaching methods and instructional materials and media. In other words, the use of microcomputers is generally presented as another teaching tool.

6. In some institutions, broad areas of technology and related content are included in the teacher training--hardware, software, technology and society, technology vocabulary, technology implementation, programming, technology resources, and technology futures.

7. In general, teacher training methodology and the delivery system have not been altered substantially by technology.

8. Resource allocation for teacher training has been altered by technology in all institutions surveyed.

9. Faculty evaluation and their compensation have been impacted only minimally by technology in all institutions surveyed.

Summary and Implications

Public School Settings

Overall, most elementary and secondary school districts are in the initial phases of planning and implementing the use of technology in the educational system. Many districts have been using technology for administrative and management services for longer than they have used it for instructional purposes. Some districts have focused heavily on the development of new courses about computers or using computers, while others have focused heavily on teacher training. New policies regarding technology are evident in all districts.

Overall, the impact of technology on the instructional program is rather moderate. Most elementary curricula have remained unchanged, with teachers using the computer as another teaching tool to support or supplement the regular program of instruction. At the secondary level, many new courses have been added as electives to the curriculum, but little has been done in the direction of interdisciplinary involvement. Outside of computer science and the disciplines of mathematics, science, and vocational education, secondary education is remarkably unchanged.

Technology has had a high impact on the attitude of students, teachers, and parents. Despite some "technophobia" or fear of computers, the new technology has generated a great deal of interest from all involved in education. One respondent noted that technology has created a new enthusiasm for teaching and learning and may become a new bond which links teachers and students.

Respondents disagree as to the future role of technology in education. Some view the computer as just another learning tool, one that will be important for instruction insofar as it facilitates teaching and learning. Others believe that the use of the computer can make true individualization of instruction a reality. And others believe that educators must now rethink the role of the teacher within a new structure of the classroom, one which fully incorporates the computer into instruction while the teacher guides and manages more than teaches. In any case, until software addresses the development of higher-order thinking and reasoning skills as well as the interactve nature of learning, the computer will remain just another learning tool and the teacher will remain the provider of instruction.

It is expected that the strongest long-term impact of technology for instruction will be in those districts which develop a carefully coordinated plan that integrates all aspects of the technology effort. A well conceived plan should address the following aspects:

1. goals of plan
2. explicit policy and its implications
3. implementation strategy
4. instructional focus and curriculum objectives,

by level and disciplines
5. number and type of involved students
6. appropriate hardware and software
7. financial resources
8. maintenance
9. physical facilities
10. teacher training
11. staff coordination
12. technology program evaluation

All of the above factors should be considered simultaneously in order to truly implement a cost-effective technology effort that will have a high impact on the instructional program.

Colleges/Universities

Generally, the elementary and secondary schools are leading the colleges and universities in new information technology, particularly instructional applications. This is evident in the breadth (number of disciplines involved) and the depth (drill, practice, simulations, problem solving) of software that is being used. Also, many more elementary and secondary teachers than college and university faculty have improved their technology competencies. The study revealed that all elementary and secondary schools surveyed plan and operate their own inservice training programs; none relied exclusively on available college and university training.

Nevertheless, the pattern of development in the instructional program, policy structure, and management support services is quite similar between the public school settings and the higher education institutions. In the instructional programs, more impact is felt from the addition of new courses

and programs than in the modification of existing ones. In policy structure, financial allocations have been greatly changed as a result of the new technology, and there is a strong concern to claim computer literacy as a requirement for graduation (at least from the Education departments). In management support services, the use of technology is more firmly established and understood than for instructional purposes.

Colleges and universities have complex problems in planning and implementing technology-based teacher training systems. Competition with other departments for available funds is intense. Many traditional teacher training courses do not have available complementary software and courseware. The institutional constraints on developing entirely new courses, sequences, and the like are formidable. Many tenured faculty members are ill-prepared to utilize new technology. Most important, the computing and other technology-based competencies needed by educators have not been specified and agreed upon by colleges, universities, and public schools. Perhaps one of the strongest reasons that teacher training is approached in a more haphazard way in the colleges/universities than in the public schools is that faculty members in higher education hold sacred a high degree of autonomy. Many do not voluntarily choose to upgrade their skills in a new area, whereas teachers in elementary and secondary education often are mandated, or at least given strong motivation from pay or credit, to do so.

Overall Summary

A common thread to all the case studies is the relative newness of the incorporation of technology into all areas of the systems. Although some of the institutions have been using mainframe computers for many years for such tasks as research, program evaluation, and management support services, the advent of the microcomputer has opened up a myriad of new uses, particularly for instructional purposes. As a result of the many new possibilities, educators have begun to address such issues as what constitutes computer literacy for students and teachers, what role the computer plays in the classroom learning environment, and what responsibilities educational administrators must accept to insure students are properly prepared for the new information society.

These are difficult issues to face; solutions will not be easily found but rather, will evolve over time. However, attitudes are generally positive, motivation is high, and initiative abounds. The most accurate description of the "state of the art" is that of an embryo, changing so rapidly that by the time it is described as of today, it will be an entirely new creature tomorrow.

It is imperative that educators share information about approaches and strategies found to be effective, as well as issues that must be addressed in the planning and implementation of a technology program, to avoid duplication of effort and error and effect the most positive changes from the new information technologies in education.